Archaeopteris

Archaeopteris is an extinct genus of tree-like plant with fern-like leaves. A useful index fossil, this tree is found in strata dating from the Upper Devonian to Lower Carboniferous (383 to 323 million years ago), the oldest fossils being 385 million years old,[1] and had global distribution.

Until the 2007 discovery of *Wattieza*, many scientists considered *Archaeopteris* to be the earliest known tree. Bearing buds, reinforced branch joints, and branched trunks similar to today's wood, it is more reminiscent of modern seed-bearing trees than other spore bearing taxa; It combines characteristics of woody trees and herbaceous ferns, and belongs to a group of extinct plants sometimes called the progymnosperms, plants with gymnosperm-like wood but that produce spores rather than seeds.

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Taxonomy

John William Dawson described the genus in 1871. The name derives from the ancient Greek ἀρχαῖος (*archaīos*, "ancient"), and πτέρις (*ptéris*, "fern"). *Archaeopteris* was originally classified as a fern, and it remained classified so for over 100 years. In 1911, Russian paleontologist Mikhail Dimitrievich Zalessky described a new type of petrified wood from the Donets Basin in nowadays Ukraine. He called the wood *Callixylon*, though he did not find any structures other than the trunk. The similarity to conifer wood was recognized. It was also noted that ferns of the genus *Archaeopteris* were often found associated with fossils of *Callixylon*.

Archaeopteris

Temporal range:

Late Devonian to Early Carboniferous

Pre€ € O S D C P T J K PgN

Archaeopteris hibernica

Scientific classification

Kingdom:	Plantae
Division:	†Progymnospermophyta
Order:	Archaeopteridales
Family:	Archaeopteridaceae
Genus:	***Archaeopteris*** Dawson (1871)

Species

- *Archaeopteris fissilis*
- *Archaeopteris halliana*
- *Archaeopteris hibernica*
- *Archaeopteris macilenta*
- *Archaeopteris obtusa*
- *Archaeopteris notosaria*

In the 1960s, paleontologist Charles B. Beck was able to demonstrate that the fossil wood known as *Callixylon* and the leaves known as *Archaeopteris* were actually part of the same plant.[2][3] It was a plant with a mixture of characteristics not seen in any living plant, a link between true gymnosperms and ferns.

The genus *Archaeopteris* is placed in the order Archaeopteridales and family Archaeopteridaceae. The name is similar to that of the first known feathered bird, *Archaeopteryx*, but in this case refers to the fern-like nature of the plant's fronds.

A reconstruction of *Archaeopteris macilenta* from the Late Devonian, Walton Formation of Hancock, New York

Relationship to spermatophytes

Archaeopteris is a member of a group of free-sporing woody plants called the progymnosperms that are interpreted as distant ancestors of the gymnosperms. *Archaeopteris* reproduced by releasing spores rather than by producing seeds, but some of the species, such as *Archaeopteris halliana* were heterosporous, producing two types of spores. This is thought to represent an early step in the evolution of vascular plants towards reproduction by seeds,[4] which first appeared in the earliest, long extinct, gymnosperm group, the seed ferns (Pteridospermatophyta). The conifers or Pinophyta are one of four divisions of extant gymnosperms that arose from the seed ferns during the Carboniferous period.

A polished round of permineralised wood of *Callixylon whiteanum* from the Late Devonian Woodford Shale of Ada, Oklahoma

Description

The trees of this genus typically grew to 24 m (80 ft) in height[5] with leafy foliage reminiscent of some conifers. The large fern-like fronds were thickly set with fan-shaped leaflets or pinnae. The trunks of some species exceeded 1.5 m (5 ft) in diameter. The branches were borne in spiral arrangement, and a forked stipule was present at the base of each branch.[5] Within a branch, leafy shoots were in opposite arrangement in a single plane. On fertile branches, some of the leaves were replaced by sporangia (spore capsules).

Other modern adaptations

Aside from its woody trunk, *Archaeopteris* possessed other modern adaptations to light interception and perhaps to seasonality as well. The large umbrella of fronds seems to have been quite optimized for light interception at the canopy level. In some species, the pinnules were shaped and oriented to avoid shading one another. There is evidence that whole fronds were shed together as single units, perhaps seasonally like modern deciduous foliage or like trees in the cypress family Cupressaceae.

The plant had nodal zones that would have been important sites for the subsequent development of lateral roots and branches. Some branches were latent and adventitious, similar to those produced by living trees that eventually develop into roots. Before this time, shallow, rhizomatous roots had been the norm, but with *Archaeopteris*, deeper root systems were being developed that could support ever higher growth.

Habitat

Evidence indicates that *Archaeopteris* preferred wet soils, growing close to river systems and in floodplain woodlands. It would have formed a significant part of the canopy vegetation of early forests. Speaking of the first appearance of *Archaeopteris* on the world-scene, Stephen Scheckler, a professor of biology and geological sciences at Virginia Polytechnic Institute, says, "When [*Archaeopteris*] appears, it very quickly became the dominant tree all over the Earth. On all of the land areas that were habitable, they all had this tree".[6] One species, *Archaeopteris notosaria*, has even been reported from within what was then the Antarctic circle: leaves and fertile structures were identified from the Waterloo Farm lagerstätte in what is now South Africa.[7]

Archaeopteris sp. – reconstruction at MUSE - Science Museum in Trento

Scheckler believes that *Archaeopteris* had a major role in transforming its environment. "Its litter fed the streams and was a major factor in the evolution of freshwater fishes, whose numbers and varieties exploded in that time, and influenced the evolution of other marine ecosystems. It was the first plant to produce an extensive root system, so had a profound impact on soil chemistry. And once these ecosystem changes happened, they were changed for all time. It was a one-time thing."[8]

Looking roughly like a top-heavy Christmas tree, *Archaeopteris* may have played a part in the transformation of Earth's climate during the Devonian before becoming extinct within a short period of time at the beginning of the Carboniferous period.

Archaeopteris notosaria fronds from the Waterloo Farm lagerstätte in the Eastern Cape, South Africa. These represent the only high latitude species of *Archaeopteris* as yet described.

See also

- *Calamites*
- *Glossopteris*
- *Lyginopteris*

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External links

- History of Paleozoic Forests: the Early Forests and the Progymnosperms (https://web.archive.org/web/20041210054209/http://www.biologie.uni-hamburg.de/b-online/kerp/seite4.html)
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